DOCUMENT RESUME

ED 053 807 PS 004 906

AUTHOR	Rohwer, William D., Jr.; Grotberg, Edith H., Ed.
TITLE	Designs and Proposal for Early Childhood Research: A New Look: On Attaining the Goals of Early Childhood Education. (One in a Series of Six Papers).
INSTITUTION	Office of Economic Opportunity, Washington, D.C. Office of Planning, Research, and Evaluation.
PUB DATE	71
NOTE	29p.
EDRS PRICE	EDRS Price MF-$0.65 HC-$3.29
DESCRIPTORS	*Early Childhood Education, *Educational Objectives, *Individual Differences, Motivation, *Research Design, Research Needs, *Skill Development, Teaching Methods

ABSTRACT

A detailed analysis of the objectives of education and the practices of schooling leads to the suggestion that neither are being achieved. Proposed is a revised statement of the goal of education: Education is to assist the student to be adaptive with respect to extra-school tasks. The following educational objectives seem relevant to realizing this goal: To promote the student's acquisition of: (1) a repertory of skills for accurately locating and efficiently learning new information and new skills; (2) a repertory of skills for solving problems; and (3) motivational systems that will incline him to engage in learning and problem solving on a continuing basis. One obligation is to determine the character of the skills needed, the optimal timing for instruction in these skills, and the optimal methods of instruction. The major portion of this paper is concerned with examination of this obligation. Included are a description of selected prerequisite skills, accounts of what is known about the emergence of such skills depending on characteristics of the student, information on what is known about instruction designed to promote the emergence of the skills, and notes on what is not known about these skills. (NH)

ED053807

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DESIGNS AND PROPOSAL FOR EARLY CHILDHOOD RESEARCH: A NEW LOOK: ON ATTAINING THE GOALS OF EARLY CHILDHOOD EDUCATION

William D. Rohwer, Jr.

Edith H. Grotberg, Ph.D., Editor

One in a Series of Six Papers

OFFICE OF ECONOMIC OPPORTUNITY
OFFICE OF PLANNING,
RESEARCH AND EVALUATION, PRE/R

1971

PS 004906

On Attaining the Goals of Early Childhood Education

William D. Rohwer, Jr.
University of California, Berkeley

Research and development efforts in early childhood education have achieved notable success. Substantial advances have been made in knowledge of the course and of the determinants of intellectual development during the infant, preschool and primary years. In addition, it is now demonstrable that the intellectual development of children from low income families can be effectively fostered during these years. A satisfactory level of momentum has been established with respect to both the interest and the effort devoted to the early childhood years; barring fiscal betrayal, this momentum should eventually increase markedly the quality and outcome of preschool and primary schooling.

Unfortunately, the prospects are neither this bright nor this immediate for understanding intellectual development or for improving schooling beyond these years. An intent to achieve these goals confronts two major obstacles: first, the terminal objectives of formal schooling are not well-specified and, second, the character of intellectual functioning beyond the early childhood years has received virtually no research explication. These two obstacles are by no means unrelated and if schooling is to be improved, both must be eliminated. The issue of objectives is important for all of the reasons that are usually given but in the present context it has another significance as well, namely, that without such goals it is impossible to detail the relationships between the learning demanded of students in one level of formal schooling and that demanded at subsequent levels. One cannot confidently answer the question whether or not the skills and information acquired in elementary school, for example, are necessary, or even helpful, for the acquisition of skills and information demanded by subsequent schooling. A similar issue arises in connection with the character of intellectual functioning: it remains unknown whether the aided achievement of intellectual competence during early childhood is prerequisite or even facilitating of the achievement of competence during later years. Thus, in view of the massive state of our ignorance on these matters and in view of their import, the objective of this paper is to provide a documented rationale for the recommendation that relevant funding agencies, including especially the Office of Economic Opportunity, should provide support for a new departure in research on cognitive development as it pertains to education: research that focuses on the late childhood and early adolescent years.

EARLY CHILDHOOD EDUCATION

In a widely-noted recent article, Jensen (1969) reviewed studies evaluating the results of early education programs designed for children from low income families. In summary, Jensen reached the conclusion that, "Compensatory education has been tried and it apparently has failed" (p. 2). It is remarkable that the opposite conclusion can be

justified just as well: early childhood education programs have been tried and they apparently have succeeded.

The fact that the truth of these ostensibly contradictory conclusions can be asserted simultaneously deserves explication. Such an examination can begin by agreeing that the criteria for evaluating programs designed to promote educational advancement in early childhood principally include successful performance on standardized tests of scholastic achievement and of intelligence, that is, IQ tests. Judged in this way, the evidence is compelling that large-scale programs, such as Head Start, have apparently failed (Evans, 1969). But the evidence is equally compelling that a number of small-scale efforts have succeeded (much of this evidence is also reviewed by Jensen, 1969, pp. 104-107). Examples of such evidence that bear up under close scrutiny are provided in the reports of Weikart (1967) and Karnes, Taska and Hodgins (1970) as well as the better-known programs of Bereiter and Engelmann (1966). Thus, if the appropriate distinction is made between research and development efforts on the one-hand and implementation efforts on the other, it is a relatively straightforward matter to rationalize the contradiction between judgments of both success and failure: the research and development phases of early childhood programs have succeeded but the implementation phases, thus far, have largely failed.

Unfortunately, the critiques of the success of early childhood education programs cannot be disposed of as easily as the discussion thus far indicates. For example, another point made by Jensen (1969) is that even the demonstrable benefits produced by some small-scale programs often disappear over time; gains observed in treatment groups relative to control groups at the end of preschool programs diminish by the end of the first or second grades of formal schooling. Although the empirical data in support of this point are not unequivocal, it warrants serious examination for the purpose of improving the terminal benefits expected from schooling programs.

Jensen, himself (1969) has offered an hypothesis to account for the apparent fact that the benefit of early childhood training diminishes with time. In brief, this hypothesis posits two general varieties of learning ability, associative and conceptual. The first is characterized by the establishment of direct connections between stimuli and responses such that performance observed to result from learning is a near replica of the stimulus materials presented. In contrast, conceptual learning processes involve transformations of presented information eventuating in performances representing substantial transfer from the input. The hypothesis assumes a normative developmental trend such that during the age span of approximately five to seven years, conceptual processes come to dominate associative processes in the intellectual activities of the child. It is further assumed that school instructional practices fit this presumed shift such that the learning tasks presented to children become increasingly conceptual in their demands with succeeding grade levels. Finally, it is assumed that, on the average, conceptual modes of learning become dominant earlier and reach a higher asymptote in children who are white and of high socioeconomic status (SES) than in children who are

black and of low SES. All of these assumptions, taken together, provide an account of the presumed phenomenon that the benefits derived from early childhood programs by children from low income families diminish with advancement through the school curriculum (Jensen, 1970). That is to say, effective preschool programs are designed to capitalize on the associative learning predilections of low-SES children, emphasizing the improvement of associative skills and providing practice in the acquistion of prescribed content through associative learning processes. Beyond preschool, however, instruction is designed for learning by means of conceptual processes. Since such processes are characteristic of high-SES children but not of low-SES children in the elementary age range, the benefit of preschool programs for the disadvantaged diminishes over succeeding grade levels. The solution proposed by Jensen (1969) is that instructional practice should be revised so that the demands of learning tasks in the elementary years match the associative character of learning processes in low income children.

Later, the validity of this account will be questioned. For the moment, however, it is important to note that the phenomenon of diminishing benefit, or of cumulative deficit, must be attended to if the goal of effective education is ever to be reached. In order to do so, it is necessary to resolve a prior issue, namely, the issue of specifying the meaning of the phrase, "effective education."

OBJECTIVES OF FORMAL SCHOOLING

The effectiveness of schooling practices should be judged by the degree to which they assist the student to be adaptive with respect to extra-school tasks. The only intra-school tasks that should be regarded as indices of academic success must either be isomorphic with, or must entail the use of skills that are prerequisite for, effective performance on extra-school tasks.

The applicability of this prescription for the evaluation of instructional practices is clearest in the case of those segments of schooling that are nearest, in time, to occasions when it is appropriate and/or demanded that students perform successfully extra-school tasks. This feature of extra-school criteria, however, need not obscure their utility at all grade levels. It may be useful in this connection to borrow the familiar psychometric distinction between concurrent and predictive validity. That is to say, an instructional practice should be adjudged valid for implementation at the second grade level either because it assists the students in meeting extra-school demands placed on second-graders (concurrent) or because it is necessary or, at the very least, facilitating for the acquisition of other skills that promote successful management of extra-school demands that the student will face later in his life (predictive). No instructional practice should be implemented unless its validity in one of these two senses, concurrent or predictive, can be demonstrated empirically. And, in no case, should a student's school attainments be evaluated by a standard that does not have demonstrable concurrent and/or predictive validity for extra-school demands.

It may be useful to highlight the preceding prescriptions by contrasting them with methods presently in use for legitimizing instructional practices. Doing so, however, is fraught with difficulty since schooling practices vary so widely at all levels of public education in the United States. With this caution in mind, it can be said that instructional practices and evaluation of student progress almost never have validity in a concurrent sense. It is difficult, for example, to propose a concrete illustration of the manner in which third-grade curricula, instruction, and evaluation relate to the tasks faced by a third-grade in the home, peer and community domains of his life.

Ostensibly, it is predictive validity rather than concurrent validity that seems to provide legitimacy for current school practices. It is argued that successful learning in college is necessary for post-college success, that successful performance in secondary school is necessary for success in college, that successful performance in elementary school is necessary for success in secondary school, and so on back to the learning presumably fostered by preschool education programs. Thus for example, it might be asserted with considerable apparent justification that the acquisition of reading skills in the primary grades is the sine qua non for eventual occupational competence.

This way of legitimizing present school practice is vulnerable in two of its aspects. One of these concerns the timing of demands made on students of learning particular contents and skills during specified periods of schooling. These demands are justified in terms of the notion of critical periods, as in the case of reading or language acquisition, or in terms of the presumption that the skill or content is prerequisite for some subsequent learning. Either means of justification is defensible provided that it is demonstrably valid; the problem is that for many aspects of school learning, neither a critical period (Kohlberg, 1968) nor prerequisite status has been demonstrated empirically.

For example, consider the sacred cow of reading proficiency. Reading instruction begins almost uniformly with the onset of formal schooling, usually at age five, and the child's progress in reading typically becomes the major desideratum for judging his success in school. Yet there is no compelling evidence that delaying the onset of reading instruction by one or even several years would retard the rate at which the component skills are acquired. Furthermore, there is no persuasive evidence that reading is the principal means by which the student can acquire the other kinds of information that might be useful to learning during the first five years of schooling; even given current schooling practices the evidence for this is thin and it is much more thin with respect to the issue whether or not the presentation of information in text form is optimal for learning in the case of highly proficient readers.

Alternatively, consider another example of the vulnerability of schooling practices with respect to the matter of the timing of learning demands: the age of onset of formal schooling. There is little evidence to support the rationale for progressively lowering the age of required school entrance if by evidence one requires data demonstrating a positive effect of early school entrance on later school achievement. Some of the

studies already reviewed show that early childhood education programs can promote higher levels of school achievement in the early grades of primary school but what of the effects of early school entrance on academic accomplishment in secondary school? Is the evidence persuasive enough to warrant a recommendation that formal schooling be mandatory for all three year olds? Unfortunately, a decisive answer cannot be gi en for the question at present. Some available studies, however, appear to support a negative answer. (Also see Elkind, 1969.)

In a cross-national study of mathematics achievement (Husen, 1967), stratified samples were drawn from the total population of all students enrolled in the modal grade for thirteen year olds in 12 different nations: Finland, Germany, Japan, Belgium, Sweden, Israel, France, Netherlands, Australia, England, Scotland, and the United States. Among other observations, for each student a score was obtained on a standardized test of mathematics achievement and, in an attitude inventory, on a scale designed to r flect the degree of positive attitude toward school. For each national sample, information was also obtained yielding the median age of school entry. Thus it is possible to rank the sample in terms of age of schoc l entry and to obtain rank correlation coefficients between this variable and those of ranked mean mathematics test scores and ranked mean attitude-toward-school scores. The results reveal a negligible negative correlation between age of school entry and mathematics achievement (rho = -.06, $p > .05$) and a strong negative correlation between entry age and attitude toward school (rho = -.72, $p < .01$). The average performance of students on the mathematics test did not improve significantly as a function of additional years of schooling despite the fact that the extremes of the nations sampled were separated by nearly two years of formal academic work. More alarming is the suggestion inherent in the high negative correlation between entry age and attitudes toward school that the longer the student was enrolled prior to testing the more negative his attitudes toward school itself. Clearly, there is no indication in these results that revising the mandatory age of school entry to younger levels would improve the student's chances of subsequent within-school success.

Of course it might be argued that these results do not confront the issue directly since the argument in favor of earlier school entry is most persuasive for low-income children. The Husen (1967) report, however, speaks directly to this point as well. For all of the students tested, information was obtained to permit a categorization of father's occupation. Accordingly, correlation coefficients can be computed separately for two large groupings within each national sample, that is, for those occupations falling in the higher-SES categories (clerical through professional) and for those falling in lower-SES categories (skilled through unskilled manual). The correlation between entry age and mathematics achievement test scores are not significantly different from zero in either case but it is interesting to note that the coefficient for the higher-SES categories is positive (rho = +.19, $p > .05$) while that for the lower-SES categories is negative (rho = -.39, $p > .05$). Thus, even in its qualified version, the presumption that early school entry promotes school success in children from lower income families finds no support in the results of the Husen (1967) study; indeed, these data appear to contradict the presumption. In these examples,

support can be found for the assertion that legitimizing curricular demands in terms of later extra-school success is vulnerable with respect to the typically rigid timing of those demands.

A second source of vulnerability in the legitimizing rationale is more serious even than the first: The evidence that academic success determines, or even related to, the level of post-school achievement is beset with a massive artifact and, therefore provides little justification for the validity of within-school criteria of student progress. The evidence itself is massive enough; there is a substantial correlation between a variety of indices of occupational attainment, prestige, status, salary, and level of educational attainment (Duncan, Featherman & Duncan, 1968). The artifact is that a specified level of educational attainment is unsually required for entry into an occupational category. An alternative way of attempting to demonstrate the predictive validity of within-school criteria of student progress is to examine the relationship between school performance within occupational categories so as to escape the artifact of educational level as an entry credential.

Hoyt (1965), confining himself to studies using this alternative methodology, has reviewed a large amount of data bearing on the relationship between college grades and adult accomplishment. The results are impressive. For the most part, there is no detectable relationship between grade point average (GPA) in college and several criteria of later achievement. In a sample of college graduates employed in non-technical business jobs, correlation coefficients between college GPA and ratings on ten scales of occupational success ranged from -.06 to +.04. The correlation between GPA and average ratings on two teaching evaluation scales in a sample of public school teachers was +.19. Similar results have been reported in a number of studies involving samples of engineers and in other studies involving samples of physicians. Rarely have significant correlations emerged between college GPA and various criteria of occupational effectiveness. When significant correlations have been observed in these studies, they hold only for the initial three or four years after the end of formal schooling. Finally, one study reviewed by Hoyt (1965) was concerned with aspects of post-school life other than occupation. Correlations were obtained between college GPA and social status of the respondent's home, his citizenship activities, cultural interests and amount of education beyond the baccalaureate degree. The only significant correlation was betwen GPA and amount of additional education and this is accountable in terms of the practical interdependence of the twc variables by way of admissions criteria. On the whole, then, available evidence is most discouraging to the view that instructional practices and within-school criteria of student progress can be legitimized in terms of their predictive validity for later-life success.

The fact that neither concurrent nor predictive validity can be demonstrated for schooling practices would be interesting but not unsettling if (a) schooling were a benign experience and (b) the degree of within-school success had only minimal negative post-schooling consequences. Were both of these statements true, schooling could be legitimized in terms of face and content validity. After all, the studies of predictive validity

showed no correlation between GPA and occupational accomplishments, not a significant negative correlation. Unfortunately, schooling is not an altogether benign experience for substantial numbers of children if such a judgment can be made by inference from drop-out rates. And the degree of school success attained, as indexed by grades at all levels has massive consequences for post-school opportunities and accomplishments, since it is a major determinant of acceptability for entrance into occupational, social and civic roles. Thus the absence of concurrent and predictive validity for the instructional and evaluation practices in schooling is not simply interesting or unsettling, it is markedly distressing.

The argument to this point may be summarized in the following way. The validity of schooling practice is judged relative to the standard set by the objective of that practice. The objectives of schooling practices are most clearly stated in the content of the instruments used to assess student progress, namely, teacher-made and standardized tests of academic achievement. That is to say, the objectives of schooling are the performances required of students by such tests. The validity of schooling objectives, in turn, is judged by the extent to which the attainment of these objectives increases the probability that the goals of education will be realized. The present review of selected evidence relevant to this latter judgment suggests that the goals of education are not adequately realized even when the objectives of education are attained; those who score well on tests do not appear to succeed any better in post-school tasks than those who score poorly on the tests. Finally, as evidenced by the frequency of poor performance in college or by the attrition rate prior to college, large numbers of students fail to attain even the objectives of education, much less its goals.

To the extent that the present analysis is valid, it calls for revision in the objectives of education and in the practices instituted to promote the attainment of those objectives. It is in order to begin a discussion of such a revision with a restatement of the goals of education assumed here. The goal of education in to assist the student to be adaptive with respect to extra-school tasks. It is plausible to presume that the set of educational objectives relevant to the realization of this goal includes prominently the following three: (1) to promote the student's acquisition of a repertory of skills for accurately locating and efficiently learning new information and new skills; (2) to promote the student's acquisition of a repertory of skills for solving problems; (3) to promote the student's acquisition and maintenance of motivational systems that will incline him to engage in learning and problem solving. It is important to emphasize that the attainment of the objectives can only be certified in a completely satisfactory way when the performances that exemplify them are under autonomous control, that is, when the environmental supports for these kinds of behavior are relatively weak or even negative.

An adoption of these objectives entails three obligations. One is to insure that the educational progress of students is evaluated in terms of the performance implied by the objectives; tests should be designed to evoke learning and problem-solving behavior, not simply the recall of the products of previous learning. A second obligation is to construct, evaluate and revise curricula and instructional practices so that they in

fact promote the attainment of the objectives. And a third obligation is to determine the character of the skills that are prerequisite to the expected terminal repertories, the optimal timing for instruction in these skills and the optimal methods of instruction.

The remainder of this paper is devoted to an examination of the third of these obligations. This examination will involve a description of selected prerequisite skills, an account of what is known about the emergence of such skills depending on characteristics of the student, an account of what is known about instruction designed to promote the emergence of the skills, and notes on what is not known about these skills.

INTELLECTUAL DEVELOPMENT AND CONDITIONS OF INSTRUCTION

The topic of intellectual development and conditions of instruction is a gigantic one. It is so large, in fact, that a comprehensive account would far exceed the scope of the present paper, even if enough were known to give such an account and it is not. Indeed, one of the principal theses of the present discussion is that much more must be known about intellectual development, and one of the aims of the paper is to suggest priorities among those topics in need of investigation. For expository purposes then, the case will be made in terms of a few examples selected to illustrate performances implied by the educational objectives previously described.

In an ironic way, American public education is still organized in accord with some of the basic assumptions of a classical philosophy of education. Principal among these is the assumption that mastery of the contents of a designated set of academic disciplines results not only in intellectually literate students, but in students amply equipped with intellectual skills as well. To be sure the particular disciplines included in the designated set have changed considerably from those characterizing a traditional classical education. Proficiency in classical language and literature, for example, is no longer expected, but this has been replaced by proficiency in modern languages and literature. Arithmetic and geometry have been replaced by modern mathematics and the expectation of proficiency in some of the social and natural sciences has been added to the set.

There is obviously nothing inherently wrong with any of these school subject matters. Nevertheless, the meaning of the term proficiency in them is open to dispute. The manner in which proficiency is judged strongly suggests that it refers to behavior demonstrating that the student has learned and can accurately recall the contents, that is the informational (both factual and theoretical) products that have been yielded by the methodologists of the various disciplines. That proficiency has this meaning is suggested by instructional as well as by evaluation practices. That is to say, instructions consist predominantly of presenting the informational products of the designated disciplines to students and of engaging the students in practice at reproducing lists of those products in response to a variety of stimuli or questions (e.g., New York State Regents Examination).

With some striking exceptions to be mentioned shortly, another possible meaning of the term proficiency receives substantially less

emphasis. In this second sense, the term refers to competence in the skills that produce the informational products in the various disciplines. Some of these skills are discipline-specific, others are more general, but in most cases they can be characterizied accurately as methods for acquiring, retaining and extending or producing trustworthy or heuristic informational products. The contrast between these two meanings of the term proficiency may be clarified by thinking in terms of examples. At the preschool level, content proficiency is illustrated by the performance of uttering the names of the months of the year in correct order; skill proficiency is illustrated by the performance of subvocally rehearsing the order of months in order to recite them. At the elementary level, an example of content proficiency is the performance of listing the capitol cities of the states, given the state names as cues; skill proficiency might be the performance of constructing a mnemonic link between each of the state names and the capitol names in order to memorize them. Content proficiency at the secondary level is exemplified in the performance of stating Ohm's law; skill proficiency by the performance of conducting experiments to test the law. At the college level, content proficiency might be expressed in the performance of answering questions drawn from a test on modern English history whereas skill proficiency might consist of writing a brief text on a subtopic of modern English history including the prerequisite performances of document research. At the graduate level, content proficiency is exemplified in answering examination questions asking for the ordered recall of experimental results in support of a psychological hypothesis about interference as a cause of forgetting; skill proficiency might consist of formulating such a hypothesis and of subjecting it to experimental test.

The examples of skill proficiency given here are only rarely assessed formally in the course of schooling and yet they are quite conservative, directed as they are to within-school criteria. The demonstration of skill proficiency could be demanded in extra-school contexts as well, such as in accounting for the great East Coast electrical blackout of a few years ago.

One justification for emphasizing content over skill proficiency during formal schooling is that the acquisition of a large volume of content is prerequisite for effective skill acquisition. Similarly, a justification for teaching in terms of abstract within-school tasks rather than in terms of concrete extra-school tasks is that real phenomena are so complex that they retard learning. A second justification for the abstracted character of education is the assumption that the abstract mode is conceptually more powerful than the concrete. None of these justifications are compelling. With regard to the first, it has not been demonstrated that the mastery of large amount of content is necessary for skill acquisition. Even if content mastery were necessary, we know that appropriate methods for presenting such content can increase learning rates so as to provide ample time for skill learning in the context of immediate relevant experiences (Rohwer, 1970). The issue raised by the second justification is also in dispute. Abstract conceptual skills, as in the capacity to manipulate symbols effectively, are surely powerful, but the evidence is not at all clear that even abstract thinkers <u>par excellence</u>, such as mathematicians, ever abandon their penchant for manipulating ideas in terms of relatively concrete exemplars.

Thus it is possible to provide a rationale for suggesting that it might be salutary for the prevailing neo-classical philosophy of education to yield to a form of education in which objectives are explicitly defined in terms of skills. Before such a change can take place, however, a number of questions demand answers. What kinds of skills can be taught effectively? What are the components of such skills? How does the timing and sequence of instruction in intellectual skills relate to characteristics of the child, characteristics such as age, IQ, SES, ethnicity? How is it possible to prevent an instructional system bent on promoting skillful graduates from producing know-nothings?

Teachable Intellectual Skills

If they can be specified in behavioral terms, virtually any intellectual skills are teachable. This assertion can be supported by empirical research that has already been conducted (e.g., Olton & Crutchfield, 1969) or by the simple observation that by the time they reach adulthood, many persons have acquired a modest but relatively effective repertory of such skills despite the fact that they have rarely received explicit instruction in them. To be more specific, at present it is plausible to believe that a variety of intellectual skills are teachable and that an enumeration of them would include virtually all of the skills that have been studied by experimental psychologists working in the areas of learning (acquisition, retention, transfer) and thinking (classification, concept attainment, problem-solving, creativity).

THE COMPONENTS OF INTELLECTUAL SKILLS

One strategy for achieving behavioral specification of the subprocesses that comprise learning and thinking skills consists of the following steps. (1) Sampling persons known to be proficient at tasks in which success depends on the learning skill(s) of interest. (2) Present such an informant sample with the designated tasks and interview the subjects with regard to the manner in which they performed the task. (3) Synthesize a list of the possible components of the subprocesses from the interview data and from other relevant data and theory. (4) Regard the list as a set of hypotheses asserting the conditions necessary and sufficient for successful performance on the tasks in question. (5) Test the hypotheses by instituting these conditions for samples of subjects who are typically less successful at such tasks than the original informant sample. (6) Revise the hypotheses in accord with the outcomes of testing. (7) Develop a training program with the objective of inducing initially less successful subjects to acquire and use the skills validated by the hypothesis testing research. Three successively stronger criteria for such a training program are: improvement in task performance as a result of training; improvement to the level characteristic of the original informant sample on criterion tasks; and, improvement on transfer, as well as on criterion tasks, to a level commensurate with that attained by subjects in the informant sample. Repeated revision of the training program, and in turn the hypotheses that guide it, should result from the inevitable failures to reach each of these successively stronger evaluation criteria.

The various steps in this strategy and the kinds of profit and loss it yields may be illustrated in terms of the program of research we have pursued during the last several years. A recounting of this case study will also provide occasions for commenting on problems in exceptional need of research and for making recommendations about promising routes to their solution.

We beg n with the objective of developing methods for assisting relatively unsuccessful learners to improve their proficiency at acquiring information. A population fitting this stipulation was presumed to be that of black school children from low-SES homes. A classification of this population as relatively unsuccessful at learning seemed accurate in terms of average performance on school achievement tests during the elementary school years as compared with higher-SES white population. Accordingly, low-SES black elementary school children were selected as the target population, high-SES white elementary school children were selected as the criterion population and, on the assumption that they exemplify learning proficiency at its peak, high-SES white college students were selected as the informant population.

Our initial aims were modest as judged by the types of tasks we took as criterial for the learning skills in which we were interested. The tasks selected were those that have received heavy use as techniques for investigating presumably basic processes of human learning, namely, the methods of serial, free recall, and, principally, paired-associate (PA) learning. Two principal considerations justified the choice of these tasks. The first was the assumption that proficient adults would display their effective learning skills on virtually all intellectual tasks. The second consideration was that in children, performance on such learning tasks, especially on paired-associate tasks, correlates substantially with performance on the longer-term learning tasks required of children in school (Rohwer & Levin, in press; Stevenson, Hale, Klein & Miller, 1968). Accordingly our work has been heavily dominated by the use of PA tasks.

For present purposes, think in terms of PA tasks where the subject is to learn pairs of nouns in such a way that when one member of such a pair is presented, he can recall and designate correctly the other member of the pair as originally presented to him. When college students are interviewed after performing a task like this, the results indicate that those students who learn best elaborate the PAs (Runquist & Farley, 1964; Bugelski, 1962; Martin, Cox & Boersma, 1965). These self-reports provide two modal meanings for the term elaboration as a method for improving learning: one verbal, the other pictorial. In the case of verbal elaboration, subjects report the activity of constructing a sentence containing the two members of each pair to be learned. On the pictorial side, they report the activity of forming a mental image of the two objects or events named by the members of a pair, usually a scene in which the two objects are somehow joined, either spatially or by virtue of their joint participation in a brief episodic narrative of some kind. Thus, an informant sample was selected, given the designated task , interviewed about the manner in which they accomplished the task, and the results of the interviews were reduced to a list of hypothesized components of skills for efficient PA learning.

For one of these hypotheses, that sentence elaboration facilitates noun-pair learning, a cross-sectional developmental study (Jensen & Rohwer, 1965) provided qualified support; this study illustrates steps four and five of the research and development strategy outlined above. Samples of high-SES white students were drawn from seven grade levels: kindergarten, second, fourth, sixth, eighth, tenth and twelfth. All were assigned the task of learning the same list of noun PAs (presented pictorially) but only half of those in each sample were instructed to formulate and utter a sentence containing the two members of each pair when the PAs were first presented. For second, fourth and sixth graders, the sentence instruction had the effect of producing performance that was as good as that observed for the older, presumably more proficient, samples. The general result for the older samples was that performance in the instructed groups was not detectably better than that in the control groups, suggesting that sentence elaboration is substantially responsible for the ability of more proficient (older) learners to exceed the performance of less proficient (younger) learners. Nevertheless, the results left the issue in doubt for two reasons: (a) the properties of sentences responsible for the elaboration effect were not specified; and more seriously, (b) a ceiling effect limiting the performance of the older samples may have artifactually yielded data confirming the hypothesis.

The first shortcoming of the Jensen and Rohwer (1965) study was eventually ameliorated by a series of investigations. These experiments led to the conclusion that sentence elaboration would effectively facilitate noun-pair learning so long as the sentences were: formed with English, not nonsense, words (Rohwer, 1966); characterized by grammatical, not random, word order (Rohwer, 1966); normal, not anomalous, with respect to selectional restrictions (Rohwer & Levin, 1968); and, so long as the word connecting the nouns in the sentence or phrase used was either a verb or a preposition--a conjunction was ineffective (Rohwer, 1966; Rohwer, Lynch, Suzuki & Levin, 1967; Suzuki & Rohwer, 1968, 1969). These conclusions seemed to be valid across a number of other variations: with and without adjective modifiers (Rohwer, Shuell & Levin, 1967); presenting the sentence at input only or at both input and output (Rohwer, Shuell & Levin, 1967; Rohwer & Levin, 1968; Ehri & Rohwer, 1969); at a variety of pacing rate combinations (Rohwer & Ammon, 1968); with pictorial or printed word materials (Rohwer, Lynch, Levin & Suzuki, 1967); with verbs implying considerable overt activity and with verbs implying little overt activity (Rohwer & Levin, 1968); with complete sentences and with phrases (Suzuki & Rohwer, 1968, 1969); regardless of the numbers of different verbs used in the list (Rohwer & Lynch, 1967); with recognition as well as with recall methods of testing (Rohwer & Lynch, 1966); and, with both high-SES white and low-SES black children as young as kindergarteners, and as old as sixth graders (Rohwer & Lynch, 1968; Rohwer, Lynch, Levin & Suzuki, 1968; Rohwer, 1967; Rohwer, Ammon, Suzuki & Levin, in press).

It is important to note that in virtually all of the studies just cited, the method of research was that of experimental manipulation (the noun pairs were presented to the subjects in verbal contexts of various kinds) rather than that of instructions in which subjects themselves generate the sentence elaboration. A comparable method of experimental manipulation

was used in an attempt to secure a similar specification of the conditions relevant to the effectiveness of pictorial elaboration for promoting efficient PA learning. Relevant studies indicated that pair members must be depicted as joined, either spatially (Davidson, 1964; Davidson & Adams, 1970; Kee & Rohwer, 1970) or by joint membership in an action episode (Rohwer, Lynch, Suzuki & Levin, 1967; Rohwer, Ammon, Suzuki & Levin, in press). This conclusion also held across both recall and recognition methods (Kee & Rohwer, 1970) and for low-SES black as well as for high-SES white children in the kindergarten to sixth-grade range (Rohwer, Lynch, Levin & Suzuki, 1968; Rohwer, Ammon, Suzuki & Levin, in press).

All of this evidence amply illustrates steps one through four of the strategy proposed for specifying subprocesses that constitute an effective learning skill. In fact, a portion of step five has been illustrated as well, that is, sentence elaboration has been found to increase the learning efficiency of subjects drawn from the target population--low-SES black school children. To complete step five, it is necessary to show that sentence elaboration not only facilitates learning in Ss drawn from the target population but that it improves performance in low-SES black children to the point of equivalence with the criterion population, high-SES white children.

INDIVIDUAL DIFFERENCES AND THE TIMING OF SKILL INSTRUCTION

We attempted to fulfill this fifth step in two ways; by comparing the performance of high-SES white elementary school children with that of low-SES black children when PAs were elaborated and when they were not; and, by comparing the effectiveness of training in self-generated elaborative techniques for the two populations. As hypothesis-testing methods, both of these are, of course quite defensible. In retrospect, however, it is difficult to rationalize the decision to sample young elementary school children from the two populations rather than older elementary or even secondary school students. In brief, the reasons favoring the decision can be described as follows. Ignoring the ceiling effect, the results reported by Jensen and Rohwer (1965) suggested that the efficiency of PA performance asymptotes between the sixth- and eighth-grade levels; therefore, it seemed implausible to envision improving performance in subjects older than sixth-graders either through presenting learning materials in elaborated forms or through training subjects in self-generated elaboration, since their expected level of performance was already optimal. Secondly, it had been shown that children as young as first-grades could profit from presented elaboration, both verbal and pictorial (Rohwer, Lynch, Suzuki & Levin, 1967) and that children as young as second-graders could profit from instructions to generate sentence elaboration (Jensen & Rohwer, 1965). Finally, the average performance of high-SES white and low-SES black elementary school children on school achievement tests regularly showed a substantial difference favoring the high-SES white . The hypothesis was that this advantage accrued from the greater relative propensity of the of the white children to engage autonomously in self-generated elaborative activities during the course of school learning. Accordingly, we expected to find a difference in PA performance favoring high-SES whites when the learning materials were not elaborated or when elaboration training would reduce the difference. In other words the expectation was that low-SES

black children would derive more benefit from elaboration conditions of learning than would high-SES white children.

Given these lines of reasoning, the indicated experiments were undertaken. The results surprised us even though they should not have. Experiments regularly failed to detect differences between the two populations sampled when elaboration conditions were manipulated by varying the manner in which the learning materials were presented (Rohwer, 1967, Experiment XIII; Rohwer & Lynch, 1968; Rohwer, Lynch, Levin & Suzuki, 1968). Furthermore, when populations differences in PA performance were detected, they emerged in the elaborated conditions more often than in the non-elaborated conditions (Rohwer, Ammon, Suzuki & Levin, in press). That is to say, in direct contradiction of the prediction, high-SES white children profited more from elaborated conditions than did low-SES black children.

Unabashed by these results, we undertook to train samples of high-SES white and low-SES black second-grade children in verbal and pictorial techniques of elaboration and to measure the effects of training in terms of performance on a transfer task (Rohwer & Ammon, in press). Each child was given instruction in the use of verbal and pictorial elaborative techniques during five daily training sessions of fifteen minutes duration each. Statistically significant positive benefits of training were observed for both samples relative to their respective controls. The magnitude of benefit, however, was rather small compared to that produced by simply presenting learning materials in an elaborated form; more improvement in performance was produced by elaborated presentation than by one and one-quarter hours of direct instruction in elaborative techniques. An even more discouraging but interesting result was that the populations difference was clearly more pronouncedly in favor of the high-SES white children after training than before!

In a final attempt to test the limits of our hypothesis we conducted another training study. In this one, the populations sampled were high-SES white and low-SES black preschool and kindergarten children. The training was similar to that provided in the previous study except that the experimental design was better and the instructional materials and procedures had been improved. Once again, performance was found to vary markedly as a function of presentation conditions; elaborated pairs were learned more efficiently than non-elaborated ones in all samples. But, the results revealed no detectable effects of elaboration training, despite the fact that eight days of 15-minute instructional sessions had been given in the manner of individual tutorials.

The question posed by the failure of these two studies to improve substantially the learning efficiency of either high-SES white or low-SES black children is the following: Why does presented elaboration facilitate learning whereas elaboration training does not? The question is challenging and the task of answering it is not an easy one. Begin with a resume of relevant facts. High-SES white and low-SES black children as young as four years of age benefit from the presentation of PAs in elaborated form (Rohwer, 1967, Experiment XII). High-SES white and low-SES black children as young as five years of age benefit from sentence-elaboration instruction

when the instructions are given immediately before the presentation of the PA list (Rohwer, 1967, Experiment XIII). Seven and one-half year old children can maintain a sentence-elaboration set over a one-week retention interval when the set is induced by means of a learning-to-learn procedure (Milgram, 1967). Arrayed against all of these instances of successful manipulation of elaboration conditions is the failure of the two studies of elaboration training to produce transferable facilitation of learning.

There are, of course, numerous differences between the successful and unsuccessful instances. The most interesting of these, however, is that in the unsuccessful cases, the criterion was performance on a transfer task where no attempt was made to reinstate the elaboration skills presumably acquired during training. In contrast, procedures in the successful studies included steps to make the elaboration set salient at the time of transfer. In the Milgram (1967) study, for example, instructions given immediately prior to the administration of the transfer lists reminded the subjects to use the learning techniques they had acquired the week before. If this is indeed the critical difference between the successful and the unsuccessful studies, it is an important one in the context of the present discussion because it bears on one of the chief educational objectives advan ed here: to promote in students the acquisition of skills for efficient learning so that they are activated autonomously, that is, in the absence of environmental support. Clearly, the attempts to accomplish this objective with young children, even in the very specialized case of PA learning, have failed.

This account of efforts to train children in the use of elaborative skills is reminiscent of two other lines of research in experimental child psychology: research on production and mediation deficiencies (cf. Flavell, 1970), and research on facilitating the acquisition of skills characteristic of the stage of concrete operations, for example, conservation skills, as described by Piaget (cf. Kohlberg, 1968). Borrowing these two sets of constructs, it might be said that with respect to sentence elaboration skills, children of the ages sampled suffer from a production deficiency, not a mediation deficiency--when it is provided, the child can use sentence elaboration but he does not autonomously produce it himself; and, children of these ages appear to have reached a transitional stage with respect to the use of elaboratio- skills, that is, they cannot be easily trained to use them on transfer tasks.

The curious aspect of these analogies is that both in the case of work on mediation and production deficiencies and in the case of developmental substages transitional to concrete operations, the chronological age range involved is typically five to seven years. In contrast, little, if any, developmental changes have been unearthed for this age range in phenomena attendant to the skills of sentence elaboration. This curiosity suggests an interesting hypothesis: the capacity for autonomous sentence elaboration becomes visible (i.e., the production deficiency disappears) in the age range identified with the emergence of formal operations rather than during that identified with the emergence of concrete operations.

Note that in addition to accounting for the failures to train autonomous

sentence elaboration in young children, the developmental hypothesis is attractive because it fits the results of other experiments that have failed to find a difference in PA learning efficiency between high-SES white and low-SES black samples of elementary school children. The expectation that such a difference would be detected was predicted on the assumption that high-SES white children in the 4 to 11 year age range typically engage in autonomous elaborative activities.

Data relevant to this hypothesis have recently been secured in an experiment designed to indicate the developmental level at which autonomous elaborative activities begin to characterize PA learning processes in children. Equal numbers of subjects were sampled from the first, third, sixth, eighth and eleventh grades in two school districts--one serving a high-SES white population and another serving a lower-SES white population. All subjects were asked to learn the same list of 36 aurally-presented noun pairs by a study-test method. Within each subsample, children were randomly assigned to four treatment conditions: control, rehearsal, presented sentence, generated sentence. Instructions for the control condition directed the subject to listen to each noun pair and to learn it in such a way that he could reproduce the second member of the pair when presented with the first. In the rehearsal condition, subjects were asked to repetitiously utter aloud each noun pair immediately after it was presented until the onset of the next pair. The distinctive feature of the presented sentence condition was that every noun pair was presented in the context of a declarative sentence and subjects were instructed to repeat the sentence aloud during the inter-term intervals. Finally, those in the generated sentence condition were asked to construct and utter repetitiously a sentence for each of the noun pairs presented. The pacing rate was the same for all four conditions. The results are displayed in Figure 1 as a function of conditions, grades and populations.

The results for the low-SES white samples are relatively simple to describe: differences between the two sentence conditions were detectable only in the sixth grade sample where generated sentences produced better performance than presented sentences; differences between the control and rehearsal conditions were detectable only in the eleventh grade sample where rehearsal instructions were associated with better performance than control instructions; and, at all grade levels, the combination of the two sentence conditions was associated with better performance than the combination of the rehearsal and control conditions. The control condition was the only one which permitted autonomous elaboration to occur; in the other conditions, the inter-item study-trial interval was filled by the learner's own overt verbal activity. Thus, at some point in the age range sampled, performance in the control condition was expected to show a positive shift, relative to the other conditions, because of increased autonomous elaborative activity. As the results in Figure 1 indicate, however, such a shift did not occur for the low-SES white population at any of the grade levels.

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[1] This study was conducted by Mrs. Joan P. Bean.

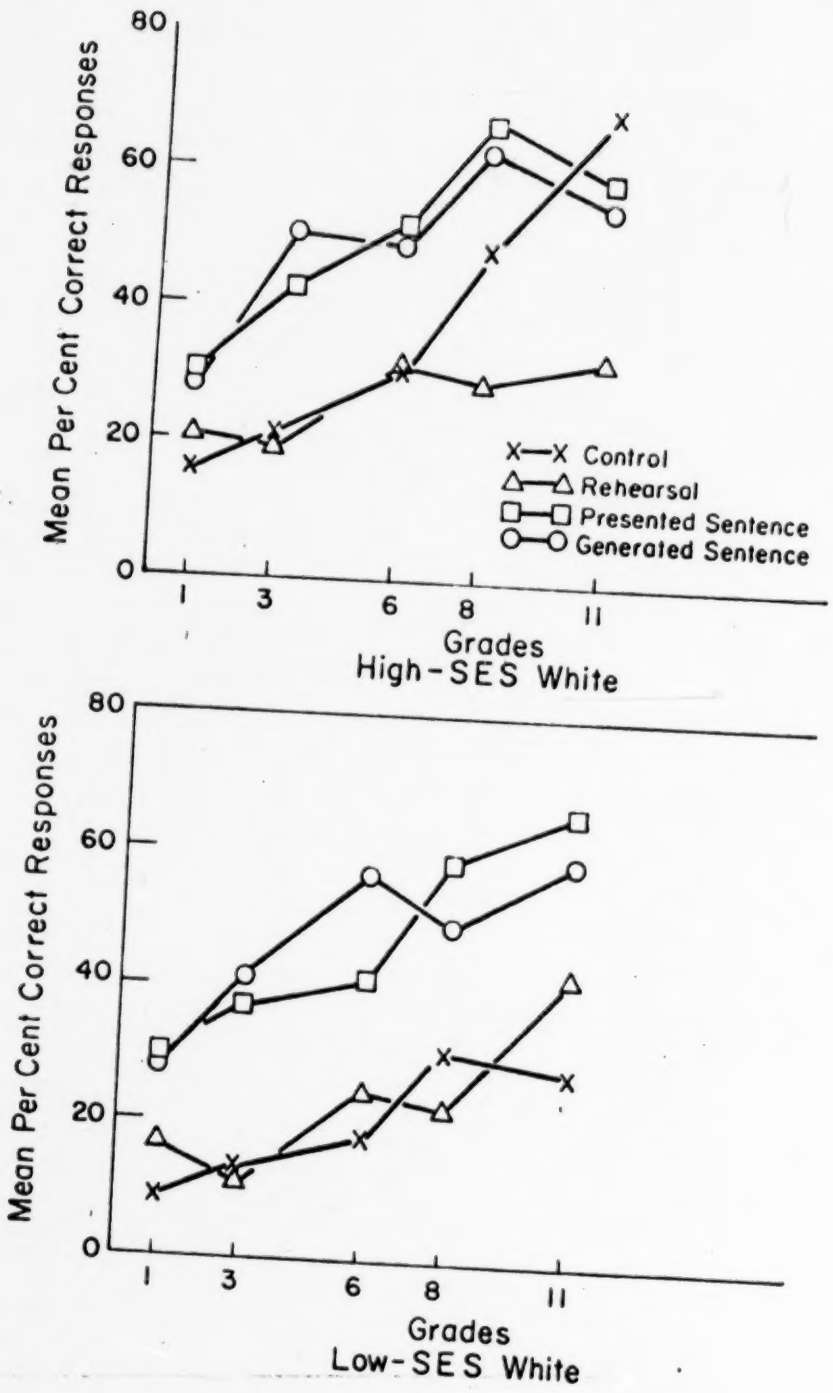

Figure 1. Mean percent responses correct as a function of conditions and grades (upper panel: high SES white; lower panel: low-SES white).

In marked contrast, the results for the high-SES white samples show a dramatic shift of precisely the kind expected across the sixth to eleventh grade range. For grades one, three and six, the pattern of results in the high-SES samples is similar to that of the low-SES samples: the control condition does not differ significantly from the rehearsal condition; the two sentence conditions do not differ significantly; and, performance associated with the sentence conditions is markedly superior to that in the control and rehearsal conditions. In the eight-grade samples, however, the pattern changes such that the control condition is significantly superior to the rehearsal condition although still inferior to that in the two sentence conditions. And, by the eleventh grade, the shift appears to be complete: the control condition is better than any of the others, including both sentence conditions even though the sentence conditions are still superior to the rehearsal condition. Apparently, autonomous elaborative activity, at least on this PA task, begins to emerge in high-SES white samples in the age range 11 to 14 years but does not emerge in low-SES samples even by age 17. Finally, the deficiency in PA learning efficiency between high- and low-SES samples in the control condition becomes pronounced only in the age range spanned by the sixth to eleventh grade samples, not in the first and third-grade samples. Accordingly, the conclusion is compelling that attempts to assist low-SES students to increase their learning skills through training in autonomous elaborative activity are more appropriate in the adolescent than in the early childhood period.

But what of the relative performance of low-SES black children, that is, the population sampled in most of the previous studies we have done? The four-condition design just described was replicated with samples of sixth- and eighth-grade students drawn from such a sample. The results are displayed in Figure 2 along with those for high and low-SES white samples at the same grade levels. The conclusions drawn from the contrast between the high- and low-SES white samples apply as well to the results provided by this three-population contrast. Indeed, the trends leading to the conclusions are even more pronounced in the latter contrast. Note for example, that only in the rehearsal condition did performance improve more for the low-SES blacks than for the other populations in comparisons of eighth with sixth-grade results. Further note that excepting the rehearsal condition, the populations difference favoring the high-SES whites appears substantially larger in the eighth than in the sixth-grade samples. Thus, these comparisons also suggest that populations differences attributable to enhanced autonomous elaborative activity emerge more forcefully after the chronological age of approximately eleven than chey do before.

The results of this experiment, viewed alongside the rest of the comparative research we have conducted, lend credence to the hypothesis that direct training toward the objective of promoting the autonomous use of effective learning skills will achieve substantially more success with children in the early adolescent age range than in the early childhood range. The hypothesis raises a number of intriguing questions. Among these, three are of direct concern here. First, do the results of the PA experiment just described generalize to other tasks, that is, do they reveal a developmental phenomenon that is not task specific? Second, what are

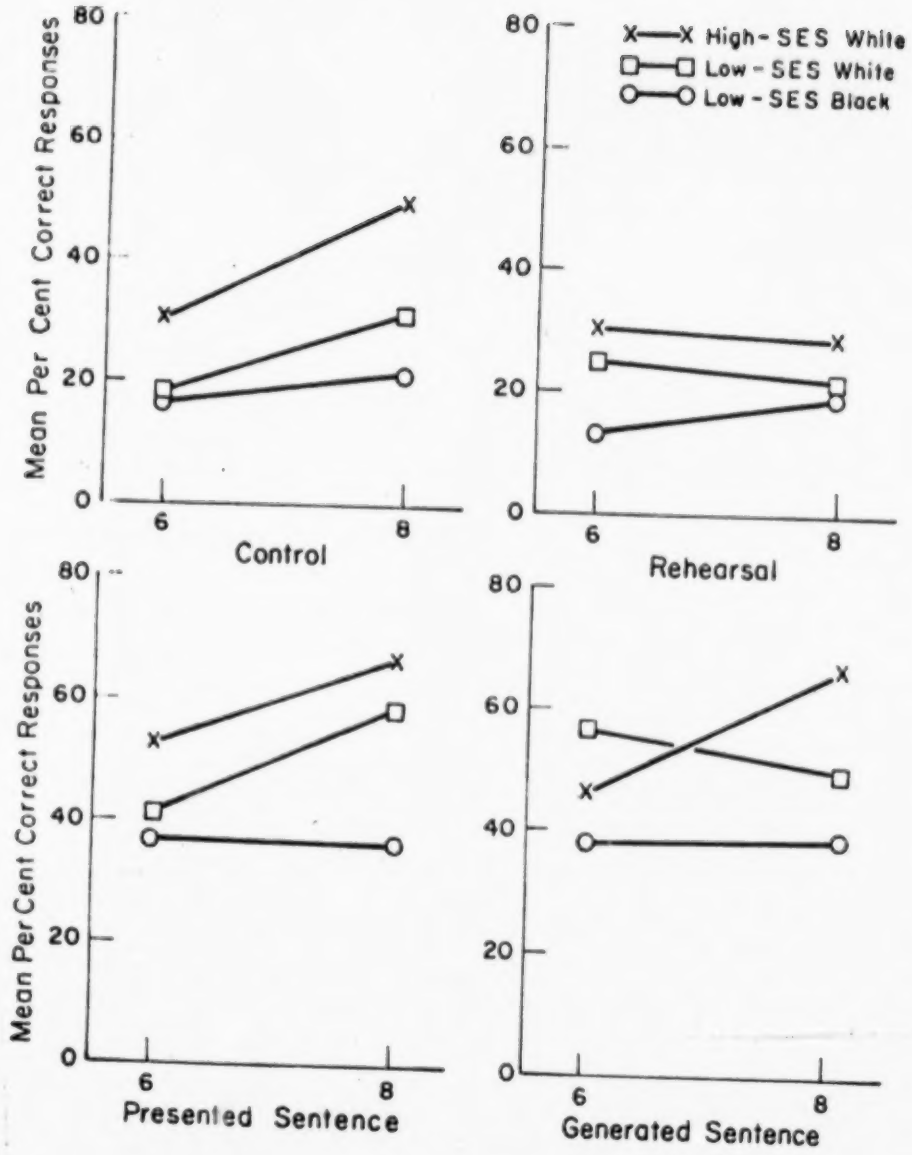

Figure 2.

Mean percent responses correct as a function of conditions, grades, and populations.

the effects of prior formal schooling on the emergence of autonomous learning skills and do these effects, if there are any, vary as a function of the kind of prior schooling experienced? And, third, is it possible to successfully promote, through education, the emergence of such skills, even at the optimal age range, among low-SES students? The challenge posed by these questios is enormous, especially so in view of the fact that the necessary research has not been done to provide answers to any of them.

The first two of these questions call directly for a shift of research emphasis to the adolescent age range. Much of the research we have already conducted with younger children, for example, warrants replication with other age groups. It is only in this fashion that the remaining steps of the strategy outlined here for specifying the components of teachable intellectual skills can be accomplished.

The third question, however, deserves additional comment for it raises an issue that is freighted with more than the usual amount of political and social overtones, namely, whether or not formal schooling prior to adolescence is necessary at all and if so, what its character and objectives should be.

Literacy in a Skill-oriented Educational System

The view of intellectual development advanced here suggests that attempts to increase the autonomous cognitive competence of students are more likely to succeed if they are delayed, for many children, until near the end of the elementary school years. The view also suggests that the probability that such efforts will succeed can be further increased by (a) designing explicit instruction to promote the acquisition of autonomous intellectual skills, and (b) by evaluating student progress and instructional effectiveness directly in terms of performances that display those skills rather than prescribed, discipline-oriented content.

It should be mae explicit that the present view of intellectual development has no necessary dependence on either a maturational or a learning view of intellectual development. It does accord, in some respects, with the relatively maturational positions inherent in the views of some exponents of a Piagetian account of cognitive development. Recently, for example, Elkind (1969, p. 332) has written, "Not only is there no clear-cut longitudinal data to support the claims of the lastingness of preschool instruction, there is evidence in the opposite direction. The work cited by Jones (1954) and by Piaget (1967b) in the quotations given earlier in this paper are cases in point. This evidence, together with more recent data reported in Jensen's paper, suggest a negative correlation between early physical maturation and later intellectual attainments..... This (sic) data suggests the hypothesis that the longer we delay formal instruction, up to certain limits, the greater the period of plasticity and the higher the ultimate level of achievement. There is at least as much evidence and theory in support of this hypothesis as there is in favor of the early-instruction proposition."

The position described in this way by Elkind is also consistent with

the data reviewed earlier in this paper from the study by Husen (1967) regarding the relationship between age of school entrance and mathematics achievement at age 13. Additional evidence is easy to come by. Kohlberg (1968), like Elkind, writing from a Piagetian perspective, has reviewed a number of studies designed to assess the effects of formal schooling on the age of achieving the various component structures and skills referred to as concrete operations. When the criterion used is performance on tasks of the Piaget variety, the results typically reveal no beneficial effects of schooling (Greenfield, 1966; Goodnow, 1968; Goodnow & Bethon, 1966; Mermelstein & Meyer, 1969; Mermelstein & Shulman, 1967; Price-Williams, 1962; Vernon, 1966, 1969).

Similarly, the view advanced here, disavows optimism about the long-term advantages that can accrue from intensive programs of preschool education. Skepticism on this issue arises from two convictions: that the character of learning and thinking processes on adulthood is discontinuous, in a practical sense, with the character of such processes in early childhood and, that the character of the demands made by intellectual tasks in adulthood is discontinuous with the character of task demands in early childhood. Furthermore, the present view asserts that the character of school learning tasks at virtually all levels, as education is currently conducted, is discontinuous with the character of task demands outside of school,

Despite the fact that the present view of intellectual development shares with cognitively-inclined views enormous skepticism about the durability of effects achieved through intensive early childhood education, it has arisen from and is rooted in experimental analyses of learning phenomena. This aspect of the present view is revealed not only in the kinds of data that form its base but also in its implication that training in the use and acquisition of autonomous learning and thinking skills should be quite beneficial, provided that such training is properly timed and sequenced. For example, I am currently persuaded that low-SES white and black children in the adolescent age range can be effectively assisted to engage in the kinds of mental activity that appear to make high-SES white children so proficient on PA learning tasks without explicit and systematic instruction. Such optimism about the possible salutary effects of later educational intervention is not entirely speculative. As Elkind (1969, p. 333) notes, "While children all over the world and across wide ranges of cultural and socioeconomic conditions appear to attain concrete operations at about the age of 6 or 7 (Goodnow, 1969), the attainment and use of formal operations in adolescence, in contrast, appear to be much more subject to socioculturally determined factors such as sex roles and symbolic proficiency..." And he might have added the factor of the content and procedures of schooling.

If the views advanced here were adopted, what are their implications for the content and practice of schooling for children aged eleven or twelve and under? A strong implication might be that formal schooling prior to these ages should be abandoned on the grounds that it does more harm than good. If the hypothesis proposed by Elkind (1969) is correct, this conclusion is compelling. That is to say, if formal schooling that seeks to accelerate intellectual development prior to the adolescence

transition results in less plasticity and a lower final level of intellectual capacity, then it should surely be discarded.

Another line of reasoning that might be used to recommend the dissolution of early formal schooling is motivational in character. As illustrated by the results of the Husen (1967) study described previously, the effects of early school entrance on attitudes toward school are even more deleterious than its effects on mathematics achievement. This evidence is in accord with Elkind's view that current schooling practices often result in "intellectually burned" students, that is, children who, by the time they complete elementary school, have experienced frustration and failure so repetitiously that they view themselves as incapable of intellectual competence and see learning as incapable of affording them any satisfaction much less real joy.

My own inference from all of these considerations is not that formal schooling prior to adolescence should be abandoned, but that it should be radically changed. I have already suggested the direction of changes that seem promising to me but a reiteration at this point might be in order. The guiding principle of early education (preschool and elementary) should be to provide the child with repeated experiences of gratification resulting from intellectual activity. Lest this recommendation be grossly misread, it must be emphasized that it refers to satisfying work and play, not to training to techniques of self-indulgence and mediocrity. Accordingly, children might learn skills of auditory and visual discrimination, of counting and classifying, of feeling and satisfying curiosity, even of reading and writing during the elementary years. But mastery would not be required at a particular early age, rather at the time the child can acquire the skills (and the prerequisite subskills) readily and successfully. Furthermore, those skills selected for instruction in the pre-adolescent years would be legitimized by their validity for the accomplishment of extra-school tasks either concurrently or in the future. Finally, the evaluation of student progress and of the efficacy of instruction would be in terms of the performance of skills rather than in terms of the retention of content.

A revision of elementary schooling of this sort is certain to evoke considerable opposition despite the argument and evidence that can be marshalled in its support. If the source of this opposition is a fear, as I suspect it is, that a system of education of the kind envisioned here will result in generation of students who, intellectually and socially, are self-indulgent know-nothings, then somehow the fear must be allayed. One strategy for accomplishing this constitutes the chief recommendations of this paper. The strategy requires a set of tactics for demonstrating the practicality of promoting the development of autonomously competent persons through instruction in intellectual skills, skills of learning and thinking, beginning at the transition to adolescence. In order to achieve such a demonstration, research and development focused on the target age range must be fostered in a massive way, for at present, we know almost nothing about intellectual development during adolescence. It is particularly important that such programs of research should be comparative in nature, including populations of students from low income

families since it is precisely these populations that suffer the most practical damage and who are the most "intellectually burned" by current schooling practices. Fortunately, the yield of the proposed programs of research and development will be salutary as well for more affluent populations in which the damaging effects of schooling are better hidden but no less personally painful.

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